

Activity 9-1

The Nature of Organic Compounds

For each of the following paragraphs, numbered 1-6, choose words from the word list to fill in the blanks in that paragraph. Some lists group words that have contrasting meanings.

1. Origin and scope of organic chemistry

Word List

bonds	four	organic
carbon	living	petroleum
compounds	molecules	produced

Organic chemistry is the branch of chemistry that deals with the reactions and properties of the compounds of the element _____. In the early days, the term *organic* was applied to compounds found only in _____ organisms. It was widely believed that organic _____ could be _____ only by plants or animals. However, in 1828 urea was produced from ammonium chloride and silver cyanate by Friedrich Wöhler as the first _____ compounds to be synthesized in the laboratory. Earlier beliefs about the nature of _____ compounds were discarded and except for a few kinds of compounds such as the oxides of carbon and the carbonates, all carbon compounds came to be considered as organic.

Today, organic chemistry is the largest and most important branch of chemistry. The work of most chemists deals with _____ compounds. A very large number of organic compounds of many different types are known. This diversity exists because each carbon atom can form _____ covalent _____ with atoms of other elements and, more importantly, with other _____ atoms. There appears to be no upper limit to the number of _____ atoms that can be bonded together to form very large _____.

2. Characteristics of organic compounds

Word List

nonelectrolytes/electrolytes	positively/negatively	soluble
nonpolar/polar	organic	solvents

Molecules of _____ compounds are generally nonpolar and tend to dissolve in _____ solvents. Most of these molecules are not very soluble in polar _____ such as water. However, some molecules such as ethyl alcohol and acetic acid are sufficiently _____ to be _____ in water. Compared to the electrolytic properties of most inorganic compounds, most organic molecules are generally _____.

3. Boiling points and melting points of organic compounds

Word List

high/low	solids/liquids/gases
intermolecular	strong/weak
polar/nonpolar	

The molecules of some organic compounds are nonpolar or only slightly _____. Because of this, the _____ forces are _____. In the laboratory this characteristic is observed as relatively _____ melting points, _____ boiling points, _____ heats of vaporization, and _____ vapor pressures. At ordinary temperatures, most inorganic substances are generally solids, while many organic substances are _____ or _____.

4. The reaction rate of organic reactions

Word List

activated	faster/slower	ions
between/within	forces	rapidly/slowly
covalent/ionic	high/low	organic/inorganic

There is strong _____ bonding _____ atoms within organic molecules. In order to undergo chemical changes a significant amount of rearrangement of bonds is required. This, in turn, requires a _____ energy of activation. For these reasons, _____ complexes, the intermediate structures in reaction mechanisms do not form readily. Thus, organic reactions take place more _____ than _____ reactions. Inorganic reactions proceed at _____ rates because the _____ of attraction between positive and negative _____ increase the likelihood of forming the _____ complex.

5. Bonding in organic compounds

Word List

angle
metals/nonmetals

molecular/ionic
share/transfer

tetrahedron
four

In molecules of organic compounds, each carbon atom forms the equivalent of _____ bonds to other carbon atoms as well as other kinds of atoms. The _____ valence electrons of carbon can form _____ single covalent bonds. These bonds are directed toward the four corners of a regular _____. The bond _____ between any two of these bonds is $109^{\circ}28'$. This _____ is sometimes called the tetrahedral angle. Adjacent carbon atoms can _____ one, two, or three pairs of electrons. Carbon atoms can also _____ one, two, or three pairs of electrons with atoms of other elements, usually other _____. The forces of attraction between organic molecules cause them to form _____ solids.

6. Classification of organic compounds

Word List

decreases
chemical
homologous
increases

increment
intermolecular
number
structures

Organic compounds can be classified into groups having similar molecular _____ and similar _____ properties. Such groups are called _____ series. Each member of a _____ series differs from the preceding member by a common _____. As members of a series increase in size of molecules and _____ of electrons, the strength of the _____ forces, primarily van der Waals forces, _____. As the strength of these _____ forces increases, boiling point _____, melting point _____, and vapor pressure _____.

Activity 9-2

Hydrocarbons

1. What are the only two elements in a hydrocarbon? _____ and _____
2. What is an aliphatic hydrocarbon? _____
3. What is an aromatic hydrocarbon? _____
4. What is a homologous series of hydrocarbons? _____
5. How does the structural formula of one member of a homologous series of hydrocarbons differ from the next lower member? _____

Aliphatic hydrocarbons

Complete the following table to show the relationship between three homologous series of aliphatic hydrocarbons.

		Alkanes	Alkenes	Alkynes
6.	Other name(s) for series			
7.	General formula			
8.	Series increment			
9.	Structural formula for characteristic carbon-carbon bond			
10.	Suffix for name			
	Names and molecular formulas up to the 5-carbon member	(1)		
		(2)	(2)	(2)
		(3)	(3)	(3)
		(4)	(4)	(4)
		(5)	(5)	(5)
11.	Structural formula for 3-carbon member			

Aromatic hydrocarbons

12. What is the general formula for the benzene series? _____
13. What are the names and formulas for the first two members of the benzene series?

14. Members of the benzene series are _____ (aliphatic/aromatic) hydrocarbons.
15. Why are members of the benzene series considered to be hydrocarbons? _____
16. Draw a structural formula for benzene that shows its bonding structure as an average of single and double bonds.

Isomers

17. What are isomers? _____
18. The simplest alkane that has isomers is butane. What is the molecular formula for butane?

19. Draw structural formulas for the two isomers of butane. Label each with its IUPAC name.
20. Draw structural formulas for the three isomers of pentane. Label each with its IUPAC name.

Petroleum

21. What is petroleum? _____

22. List six kinds of chemical products obtained from petroleum. _____,
_____, _____, _____,
_____, _____.
23. What properties permit the use of fractional distillation as a means to separate petroleum into useful components? _____

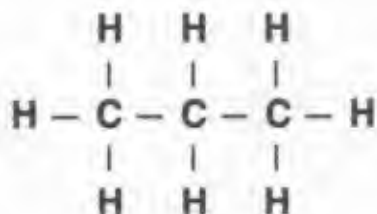
24. Describe the process of cracking as used in petroleum refining. _____

NAMING HYDROCARBONS

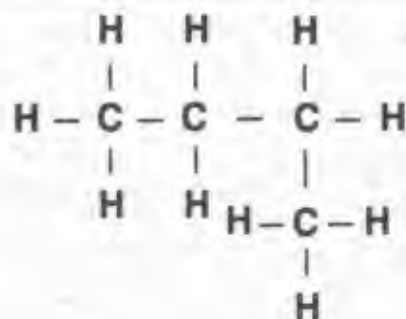
Name _____

Name the compounds below according to the IUPAC naming system

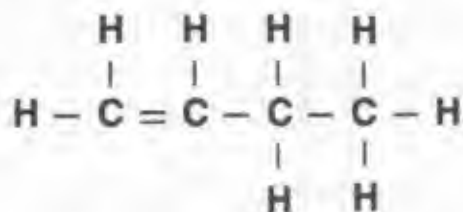
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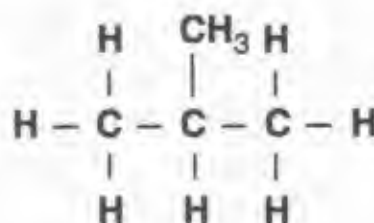
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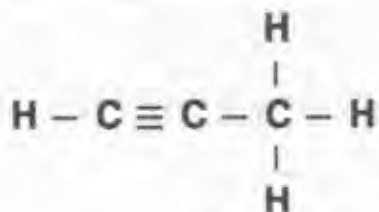
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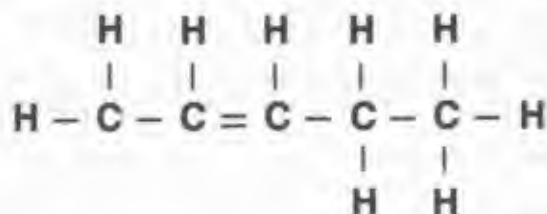
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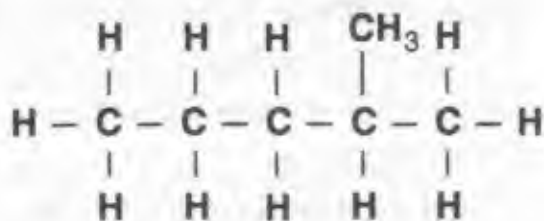
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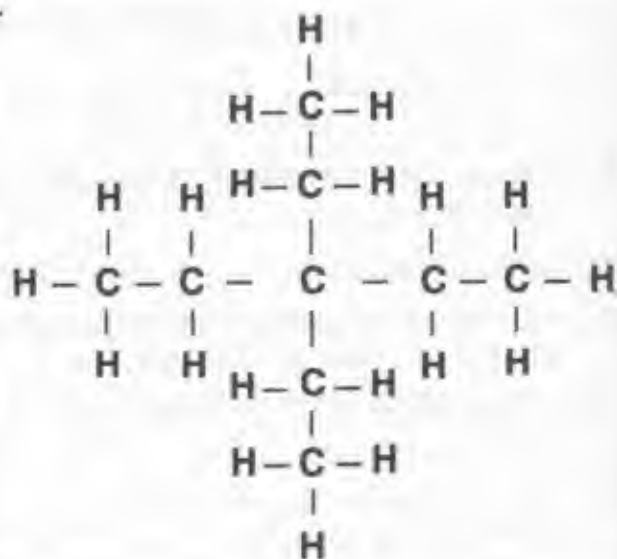
7.



4.



8.



STRUCTURE OF HYDROCARBONS

Name _____

Draw the structure of the compounds below.

1. ethane	5. ethyne
2. propene	6. 3,3-dimethyl pentane
3. 2-butene	7. 2,3-dimethyl pentane
4. methane	8. n-butyne